A STUDY OF HEMATOLOGICAL PARAMETERS AND ANTHROPOMETRIC INDICATORS IN HYPERTENSIVE AND NORMOTENSIVE MALES

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ABSTRACT

Introduction: Hypertension is one of the factors associated with stroke, congestive heart failure, heart or kidney failure. Overweight and obesity are the two most key determinants of health that leads to adverse metabolic changes including increase in blood pressure. The cellular components of blood contribute to the viscosity and volume of blood, thus playing a vital role in regulating blood pressure.

Objectives: To compare the hematological parameters and anthropometric indicators in hypertensive and normotensive males.

Materials and Methods: This was a hospital based case control study which included 60 normal healthy male subjects and 60 hypertensive male subjects. Blood pressure was measured in supine position by mercury sphygmomanometer. Hematological indices were estimated using an autoanalyzer. The data collected were entered and analyzed using software Statistical Package for the Social Science 16.0 (SPSS 16.0).

Results and Discussion: The mean levels of hemoglobin and hematocrit were significantly lower in the hypertensive group compared to the normotensives in our study. The anthropometric measurement waist hip ratio, showed a statistically significant positive correlation with systolic blood pressure. Multiple regression analysis showed waist hip ratio, hemoglobin and hematocrit were significant predictors of systolic blood pressure.

Conclusion: The present study concludes that Waist hip ratio, a simple and inexpensive anthropometric measurement can be used as a significant predictor of systolic blood pressure. Also monitoring of hematological indices like hemoglobin and hematocrit is essential in the prevention of development of cardiovascular complications in hypertension.

Key Words: Hypertension, Anthropometric indicators, Hematological indices, BMI, WHR

INTRODUCTION

Hypertension is defined as blood pressure more than 140/90 mm Hg as per US Seventh Joint National Committee on Detection, Evaluation and Treatment of Hypertension (JNC VII).¹ The prevalence of hypertension in India is 23.10 % among men and 26.60% among women.² Prevalence of hypertension in South India was found to be 20% according to the CURES 2007 study.³

Overweight and obesity are the two most important key determinants of health that leads to adverse metabolic changes including increase in blood pressure. Obesity and weight gain are independent risk factors for hypertension. Also 60-70% of hypertension in adults may be directly attributable to adiposity.⁴

Body mass index or BMI is propagated by the WHO as the most beneficial epidemiological measure of obesity. Waist hip ratio (WHR) and waist circumference (WC) are frequently used to forecast the danger of obesity linked morbidity and mortality as they account for regional abdominal adiposity. Visceral fat is a more significant determinant of blood pressure elevation than is peripheral body fat.⁵ In longitudinal studies, a direct association exists between change in weight and change in blood pressure over time.⁴

Though hypertension and obesity are closely linked but there is no universal anthropometric marker due to distinct population features. Studies in urban population showed a strong relationship between different anthropometric indicators and blood pressure levels but very little is known about these relationships in rural Indian population.⁶ ⁷ ⁸

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The cellular components of blood contribute to the viscosity and volume of blood, thus playing a vital role in regulating blood pressure. It has been newly realized that many hematological parameters varies with hypertension in comparison with normotensives. This gives a vision into the connection between blood cell defects and blood pressure. There are number of disputes in different studies with respect to variability of hematological parameters in hypertensive and normotensive subjects.

The pathophysiology of hypertension is multifactorial which is affected by sympathetic over activity contributing to alterations in hematological parameters like hematocrit, viscosity and hypercoagulability of blood. These factors change the kinetics of blood flow acting as contributory risk factor for coronary artery diseases, stroke and thromboembolism. Thus the hematological parameters gives an insight to prognosis of disease also. So the present study was therefore undertaken to compare the hematological parameters and anthropometric indicators in hypertensive and normotensive males.

The present study was carried out with the following objective:

To compare the hematological parameters and anthropometric indices in normotensive and hypertensive males.

Materials and methods

This study was conducted in Sri Manakula Vinayagar medical college hospital (SMVMCH) Madagadipet, Puducherry.

Study design:
Hospital based case control study.

Sample size: 120 subjects. We included
60 normal healthy male subjects of 35-55 years of age.
60 hypertensive male subjects of 35-55 years of age.

Data collection:
A representative sample of local population comprising of 120 subjects aged 35-55 years were selected from

1. Hypertensive patients attending medicine OPD in SMVMCH.
2. Normotensives were attendants of patients, workers in SMVMCH.

Inclusion criteria
1. Hypertensive subjects having blood pressure >140/90 mmHg.
2. Normotensive subjects having blood pressure ≤120/80 mmHg.

Exclusion criteria
Subjects with any systemic illness, subjects on drug medications (steroids, α methyl dopa) for past three months
Subjects who fulfilled the inclusion and exclusion criteria were included in the study. After explaining the nature of the study, informed consent was obtained from the study subjects.

Methodology

1. Measuring Blood pressure:
Blood pressure was measured by a mercury sphygmomanometer in supine position. Blood pressure was measured two times. The average of two readings was taken as correct systolic and diastolic blood pressure.

The classification of blood pressure is as follows:

- Normal BP: <120/80 mmHg
- Pre Hypertension: 120-139/80-89 mmHg
- Stage I Hypertension: 140-159/90-99 mmHg
- Stage II Hypertension: >160/100 mmHg.

2. Hematological parameters:
From the subjects 2 ml of blood were withdrawn to which anticoagulant solution was added and fed into the ABX Pentra DF120 Hematology analyser from Horiba Medicals Pvt Ltd.

The RBC’s, WBC’s and PLT’s are measured by an electronic impedance variation principle.

The classification of blood pressure is as follows:

- Normal BP: <120/80 mmHg
- Pre Hypertension: 120-139/80-89 mmHg
- Stage I Hypertension: 140-159/90-99 mmHg
- Stage II Hypertension: >160/100 mmHg.

3. Body weight:
Body weight was measured while the subject minimally clothed and without shoes, standing steady on a weighing scale and it was recorded to the nearest 0.1 kg.

4. Height:
Height was measured to the nearest 0.1 cm while the subject was standing barefoot in erect position with a wallmounted stadiometer.

5. Body mass index:
RESULTS

Table 1 presents the demographic characteristics and the anthropometric indices of the study participants. A significant difference however existed between the cases and controls with respect to systolic blood pressure and diastolic blood pressure (p<0.001). The mean values of blood indices are presented in Table 2. Within the hypertensive and normotensive groups, the mean levels of hemoglobin and hematocrit were significantly higher in controls compared to hypertensive patients.

Correlation analysis showed a statistically significant positive correlation between WHR and systolic blood pressure (Table 3). Hemoglobin and hematocrit showed a negative correlation with systolic blood pressure among the cases. Systolic blood pressure was also found to be positively correlated with the duration of hypertension among the cases.

Pearson’s correlation analysis showed a statistically significant positive correlation between age and duration of hypertension. Hemoglobin and hematocrit showed a negative correlation with duration of hypertension among the cases (Table 4).

Correlation analysis of Waist hip ratio with other anthropometric indicators like body mass index and waist circumference are shown in Table 5. Waist hip ratio showed a statistically significant positive correlation with the body mass index and waist circumference among the hypertensive subjects. The association was found to be stronger with waist circumference (r = 0.778) than the body mass index (r = 0.699). Figure 1 shows the regression curve of Waist hip ratio (WHR) with Body mass index (BMI) in the hypertensive subjects.

Further regression analysis with duration of hypertension as a dependent variable showed a linear relationship with hemoglobin and hematocrit levels among the cases (Table 7).

DISCUSSION

Our study showed significant differences in the mean levels of hemocrit and hemoglobin concentration between hypertensive and the normotensive subjects. The mean levels of hemoglobin and HCT were significantly lower in the hypertensive group compared to the normotensives in our study. Although a number of studies have shown significant differences in the levels of hemoglobin, RBC, MCV, HCT and MCH between hypertensive and normotensive individuals, there are also a few studies that has not shown any significant difference between the two groups.

According to Richard D. Gordon, sympathetic activity is responsible for an increase in renal afferent arteriolar constriction which in turn causes an increase in renin secretion and eventually, a rise in aldosterone secretion. Renin, via the effect of angiotensin on aldosterone, is a key factor for sodium and water retention in the body. The subsequent increase in blood volume thereby causes haemodilution and may be responsible for decreased hemoglobin and hematocrit level in hypertensives.

The other probable mechanism responsible for decrease in hemoglobin levels in hypertension may be reduced production of erythropoietin and resistance of the bone marrow to erythropoietin stimulation. Hypertension if not treated promptly leads to cardiac and renal failure. Congestive cardiac failure may also cause a low hemoglobin level due to hemodilution in later stages. Ultimately, the fall in hemoglobin concentration is ascribed to the effect of angiotensin on aldosterone, is a key factor for sodium and water retention in the body. The subsequent increase in blood volume thereby causes haemodilution and may be responsible for decreased hemoglobin and hematocrit level in hypertensives.

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These evidences suggest that cardiovascular complications in hypertension.

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We are grateful to the Sri Manakula Vinayakar Medical College and Hospital for providing the facilities to perform this study. We acknowledge the immense help received from the scholars whose articles are cited and included in references of this manuscript. We are also grateful to authors / editors / publishers of all those articles, journals and books from where the literature for this article has been reviewed and discussed.

REFERENCES

Table 1: Comparison of baseline characteristics and anthropometric indicators in hypertensive patients and controls

<table>
<thead>
<tr>
<th>Parameters</th>
<th>CASES(n=60)</th>
<th>CONTROLS(n=60)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>45.81±6.09</td>
<td>45.10±5.64</td>
<td>0.82</td>
</tr>
<tr>
<td>Height(m)</td>
<td>1.47±0.08</td>
<td>1.48±0.07</td>
<td>0.56</td>
</tr>
<tr>
<td>Weight(kg)</td>
<td>63.31±8.41</td>
<td>62.81±8.66</td>
<td>0.74</td>
</tr>
<tr>
<td>Body mass index(kg/m²)</td>
<td>28.9±3.61</td>
<td>28.4±3.77</td>
<td>0.44</td>
</tr>
<tr>
<td>Hip circumference(cm)</td>
<td>104.08±7.88</td>
<td>102.90±7.44</td>
<td>0.41</td>
</tr>
<tr>
<td>Waist circumference(cm)</td>
<td>90.86±10.88</td>
<td>90.88±10.45</td>
<td>0.99</td>
</tr>
<tr>
<td>Waist Hip Ratio</td>
<td>0.88±0.07</td>
<td>0.87±0.06</td>
<td>0.53</td>
</tr>
<tr>
<td>Systolic blood pressure(mmHg)</td>
<td>153.50±6.50</td>
<td>115.17±4.15</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>Diastolic blood pressure(mmHg)</td>
<td>91.4±12.72</td>
<td>70.36±7.06</td>
<td>&lt;0.001*</td>
</tr>
</tbody>
</table>

Data are presented as Mean ±SD.*P value ≤0.05 is statistically significant. Independent student t test was performed to analyse the data.

Table 2: Comparison of hematological indices (mean ± standard deviation) in hypertensive patients and controls

<table>
<thead>
<tr>
<th>Parameters</th>
<th>CASES(n=60)</th>
<th>CONTROLS(n=60)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>RBC count x10³(cells/mm³)</td>
<td>4.74±0.43</td>
<td>4.63±0.54</td>
<td>0.85</td>
</tr>
<tr>
<td>Hb(g/dl)</td>
<td>12.07±1.87</td>
<td>14.14±1.57</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>Hct(%)</td>
<td>35.75±5.21</td>
<td>41.15±4.22</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>MCV(FL)</td>
<td>86.41±7.18</td>
<td>87.58±5.25</td>
<td>0.31</td>
</tr>
<tr>
<td>MCH(pg)</td>
<td>29.62±2.99</td>
<td>30.15±2.47</td>
<td>0.29</td>
</tr>
<tr>
<td>MCHC(g/dl)</td>
<td>33.98±1.02</td>
<td>34.68±2.78</td>
<td>0.07</td>
</tr>
<tr>
<td>WBC count x10³(cells/mm³)</td>
<td>7.17±1.92</td>
<td>7.49±1.84</td>
<td>0.36</td>
</tr>
<tr>
<td>PLT count x10³(cells/mm³)</td>
<td>277.63±70.63</td>
<td>273.28±85.02</td>
<td>0.76</td>
</tr>
</tbody>
</table>

Data are presented as Mean ±SD.*P value ≤0.05 is statistically significant. Independent student t test was performed to analyse the data. RBC=Red blood cell; Hb=Hemoglobin; Hct=Hematocrit; MCV=Mean corpuscular volume; MCH=Mean corpuscular hemoglobin; MCHC=Mean corpuscular hemoglobin concentration; WBC=white blood cell; PLT= platelet.

Table 3: Correlation of selected variables with systolic blood pressure among the cases

<table>
<thead>
<tr>
<th>Parameters (cases, n=60)</th>
<th>Systolic blood pressure</th>
<th>R value</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body mass index</td>
<td>0.126</td>
<td>0.33</td>
<td></td>
</tr>
<tr>
<td>Waist circumference</td>
<td>0.196</td>
<td>0.13</td>
<td></td>
</tr>
<tr>
<td>Waist hip ratio</td>
<td>0.337</td>
<td>0.01*</td>
<td></td>
</tr>
<tr>
<td>Hemoglobin</td>
<td>-0.271</td>
<td>0.03*</td>
<td></td>
</tr>
<tr>
<td>Hematocrit</td>
<td>-0.293</td>
<td>0.02*</td>
<td></td>
</tr>
<tr>
<td>Duration of hypertension</td>
<td>0.260</td>
<td>0.04*</td>
<td></td>
</tr>
</tbody>
</table>

Pearson correlation analysis was performed to analyze the data. * p<0.05 is considered statistically significant.

Table 4: Correlation of selected variables with duration of hypertension among the cases

<table>
<thead>
<tr>
<th>Parameters (cases, n=60)</th>
<th>Duration of Hypertension</th>
<th>R value</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>0.273</td>
<td>0.03*</td>
<td></td>
</tr>
<tr>
<td>Hemoglobin</td>
<td>-0.571</td>
<td>&lt;0.001*</td>
<td></td>
</tr>
<tr>
<td>Hematocrit</td>
<td>-0.523</td>
<td>&lt;0.001*</td>
<td></td>
</tr>
</tbody>
</table>

Pearson correlation analysis was performed to analyze the data. * p<0.05 is considered statistically significant.

Table 5: Correlation of Waist hip ratio (WHR) with other anthropometric indicators among the cases

<table>
<thead>
<tr>
<th>Parameters (cases, n=60)</th>
<th>Waist Hip Ratio</th>
<th>R value</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body mass index</td>
<td>0.699</td>
<td>&lt;0.001*</td>
<td></td>
</tr>
<tr>
<td>Waist circumference</td>
<td>0.788</td>
<td>&lt;0.001*</td>
<td></td>
</tr>
</tbody>
</table>

Pearson correlation analysis was performed to analyze the data. * p<0.05 is considered statistically significant.
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Figure 1: Linear regression analysis between Waist hip ratio (WHR) and Body mass index (BMI) among the cases

Table 6: Multiple linear regression model of Systolic blood pressure as a dependent variable

<table>
<thead>
<tr>
<th>Independent variables</th>
<th>Nonstandardized coefficients</th>
<th>Standardized coefficients</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>B value β</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hemoglobin</td>
<td>0.941</td>
<td>-0.271</td>
<td>0.03*</td>
</tr>
<tr>
<td>Hematocrit</td>
<td>-0.365</td>
<td>-0.293</td>
<td>0.02*</td>
</tr>
<tr>
<td>WHR</td>
<td>0.343</td>
<td>0.337</td>
<td>&lt;0.001*</td>
</tr>
</tbody>
</table>

* p<0.05 is considered statistically significant. WHR=Waist hip ratio

Table 7: Multiple linear regression model of Duration of hypertension as a dependent variable

<table>
<thead>
<tr>
<th>Independent variables</th>
<th>Nonstandardized coefficients</th>
<th>Standardized coefficients</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>B value β</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hemoglobin</td>
<td>-0.625</td>
<td>-0.574</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>Hematocrit</td>
<td>-0.203</td>
<td>-0.520</td>
<td>&lt;0.001*</td>
</tr>
</tbody>
</table>

* p<0.05 is considered statistically significant.